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DISCUSSION
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393, 415, 575, 580

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Discussion of
"SURVEYS AND MAPS FOR PIPELINES"

by George E. MacDonald
(Proc. Sep. 393)

GEORGE E. MacDONALD,[1] A.M. ASCE.—The interest evidenced by Mr. Geuder's discussion is appreciated, but it does appear as though some unwarranted inferences have been drawn from the paper. Mr. Geuder's statement "but no choice of routes can be weighed with a progress such as this," implies unfamiliarity with the thought processes of route location. Every line drawn, whether on a country-wide geographical map, or a 1" = 50' photogrammetric map, is based on conscious or unconscious weighing of its location. Conscientious stereoscopic study of aerial photos during route location involves weighing of many factors, such as length of line, terrain types, river crossing sites, value of property, access for construction and maintenance, all leading to a general evaluation of the construction feasibility of the route. Granted that aerial photos alone are deficient in quantitative values, inherent in their intelligent use is the weighing of many factors affecting the choice of route.

Mr. Geuder's point, that careful, well monumented Right of Way surveys are the best professional practice, is not open to question. However, in rush construction programs, provided that the public's and the property owner's rights are fully protected by accurate map presentation of the route and freely negotiated easements, it is desirable to postpone the Right of Way monumentation until after construction. This removes the stress of a rush job from the survey, reducing the probability of errors, and has the important advantage of insuring that the monuments will not be disturbed by construction operations.

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Discussion of
"GEOMETRIC PROBLEM IN TRAVELING CRANE TRACK ALIGNMENT"

by J. E. Oliver and F. A. Maloney
(Proc. Sep. 575)

PAUL HARTMAN,[1] M. ASCE.—This paper presents a practical solution to an interesting problem. However, it seems that the required "float" action is increased by two of the recommended procedures. The first such procedure is the use of the fully reduced gage of the circular track at the S.C. and the second is the elimination of the first portion of the full spiral.

The assumption of an "equivalent" length of crane when the crane is on the spiral appears to be valid. If this is accepted, the problem is reduced to finding the locii of two corners of an "equivalent rectangle" as the other two corners move along a spiral. At any point on the spiral the radial distance between the locii represents the total amount of float action required at that point. This radial distance may be computed by a rapidly-converging trial-and-error method which is described below.

In Fig. 1 the two positions of the equivalent rectangle which determine the gages along radial line OA are shown. The dotted rectangle has been made wider than the other to exaggerate the distance AE'. The radius of the spiral at B is OB and at C it is O'C. Letting m equal the length of the spiral from the T.S. to B, the spiral angle at B is $\left(\frac{m}{L_s}\right)^2 \theta_s$. Letting n equal the distance CB, the spiral angle to C is $\left(\frac{m-n}{L_s}\right)^2 \theta_s$. Then the angle between the radii is

$$\alpha = (2m-n)\frac{n\Theta_s}{L_s}$$

The angle between CD and the tangent to the spiral at C (not shown) is

$$d = D_c f + \left(\frac{2f}{L_s}\right)^2 \frac{\Theta_s}{3}$$

where D_c is the degree of the spiral at C, 2f is the equivalent length of crane, and all lengths are expressed in stations. This reduces to

$$d = \frac{Df}{3L_s}\ (3\ (m-n) + 2f)$$

Then ϕ, the angle CAB, is equal to d - α, or

$$\phi = \frac{Df}{3L_s}\ (3\ (m-n) + 2f) - (2m-n)\ \frac{Dn}{2L_s}$$

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By assuming a value of ϕ, n may be computed ($n = e \sin \phi$) and then used to solve for ϕ. This is continued until ϕ and n check. The value of ϕ will be found to fluctuate in a regular manner about its true value as the trials are made. Three or four trials will reveal the pattern of the fluctuation and allow ϕ to be determined to the nearest second without further use of the trial and error process. For example, if three successive values of ϕ are 6°18'40, 6°06'10 and 6°10'20", the ratio of all successive corrections is 1/3, i.e. $\frac{250''}{750''}$. The next correction would be $-\frac{250}{3} = -83''$, the next $+\frac{83}{3} = +28''$, the next $-\frac{28}{3} = -9''$ and so on, the final value of ϕ being 6°09'18".

With n known the angle BOC may be computed. Distance OA is the sum of the projections of OC and AC on OA. OC is not equal to OB but may be assumed equal without appreciable error in most cases.

It should be noted that the distance 2f is a chord length which has been assumed equal to the corresponding arc length in the preceding equations. The arc length may be closely approximated for a given position of the crane on the spiral and this length used in place of 2f. Small errors in arc length will have no appreciable effect on computed gages.

The radial distance to E' (rectangle in dotted position) is computed in a similar manner. The equation for ϕ becomes

$$\phi = \frac{Df}{3L_s} (3 (m+n) - 2f) - (2m+n) \frac{Dn}{2L_s}$$

The solution when one end of side CD moves off the spiral is somewhat more complicated than the foregoing but essentially follows the method used when CD is on the spiral. It will not be explained here.

To obtain a quantitative comparison between the two methods, the following crane and spiral were assumed:

Equivalent length of crane, 2f	40 ft.
Width of crane, e	40
Length of spiral, L_s	120
Length of combining spiral, L_a	80
Radius of curve ($D_z = 60°$)	95.493
Station of T.S. (C.S.)	0 + 00

Data for this spiral are shown in Table 1. Col. 2 and 3 list the computed gage at the selected stations for point E and A of the equivalent rectangle, respectively. Col. 4 lists the gage based on the radius of the spiral. Col. 5 and 6 list the float action that would be required for this crane if the gages listed in Col. 4 were used. The plus sign indicates an outward motion and the minus sign an inward motion or reduction of the 40-foot crane gage. Since points A and E are reversed when the crane is on the far spiral, the same float action is required at each end of the crane. This amounts to a total of 0.212 feet (+0.121 and -0.091).

The exact point on the spiral where the total float action is a maximum can not be determined directly. It is approximately a distance between f and 1.5f from the S.C. As shown in the table, gages were computed for points in this range and also just beyond it. The odd stationing results from the fact that point D was arbitrarily placed at the S.C. and then moved in 5-foot increments forward along the circular curve.

A study of the tabular results shows that there is little change in the total float action within this range. A few trials should give the maximum float action for any crane and spiral with precision.

Further study of the table shows that the gage computed for the instantaneous radius of the spiral is very close to the average gage of the front and rear end of the crane except at the beginning and end of the spiral. It is also apparent that these discrepancies at the ends of the spiral account for the maximum required float action since when the crane is on the other spiral the ends are reversed.

The required float action at Sta. 0 + 00 can be reduced either by using the full length of the spiral or by arbitrarily moving the outer rail on the tangent inward so as to gradually reduce the gage from 40.000 to 39.939 feet (the average gage) at Sta. 0 + 00. The latter method seems simpler. It would reduce the float action from 0.000, + 0.121 to $\pm$ 0.061.

The required float action at Sta. 0 + 80 can be reduced by using the average gage at that point. The average gage could be used throughout the circular curve or the gage could be gradually reduced beyond the S.C. In either case the required float action would be reduced from -0.091, -0.002 to $\pm$ 0.046.

The result of these modifications is a reduction of total float action from 0.212 to 0.156 feet (2.54 to 1.87 inches). Moreover the maximum outward float is reduced from 0.121 to 0.076 feet (1.45 to 0.91 inches).

While the example undoubtedly represents an extreme which would be approached but never reached in practice, it was chosen to emphasize the points made. Practical problems in track alignment on the ground might require modification of the outlined solution somewhat but should not involve material change.

1	2	3	4	5	6
Station	Front End Gage	Rear End Gage	Navy Gage	Float Action	
				Front	Rear
0+00	40.000	39.879	40.000	0.000	+0.121
0+40	39.765	39.618	39.693	-0.072	+0.075
0+44.9	39.735	39.585	39.659	-0.076	+0.074
0+50.1	39.697	39.545	39.621	-0.076	+0.076
0+55.2	39.660	39.504	39.582	-0.078	+0.078
0+60.3	39.621	39.468	39.542	-0.079	+0.074
0+65.5	39.581	39.434	39.500	-0.081	+0.066
0+80	39.465	39.376	39.374	-0.091	-0.002

Table 1

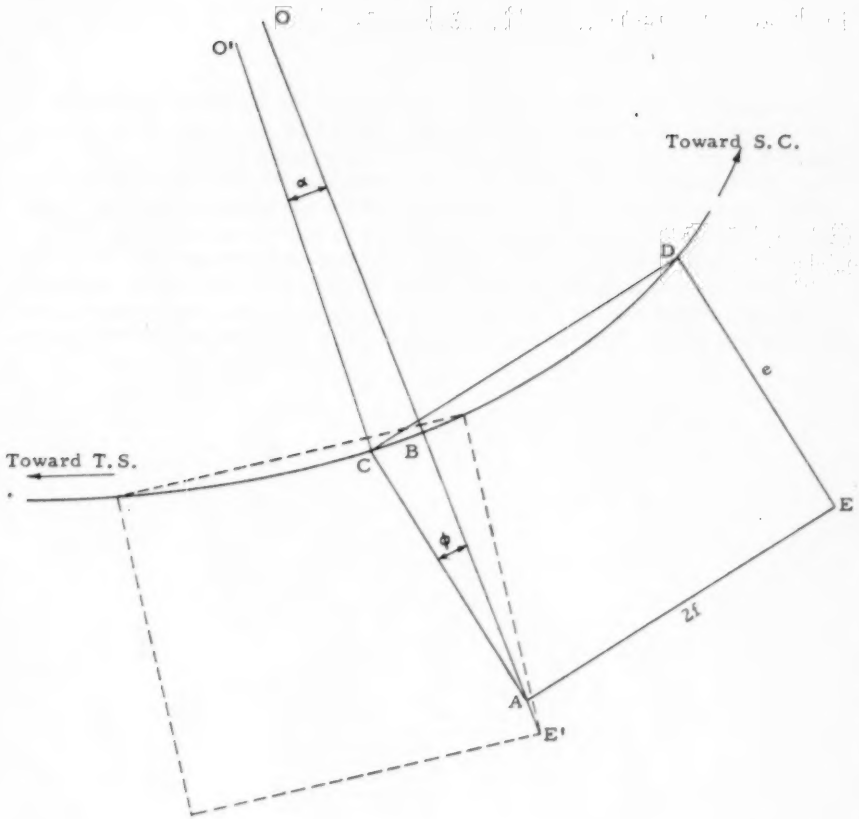

Fig. 1

Discussion of
"AN INDUSTRY PUTS THE TEXAS COORDINATE SYSTEM TO WORK"

by H. P. Cooper
(Proc. Sep. 580)

HARRY A. SERAN,[1] M. ASCE.—Mr. Cooper's paper was of particular interest to me because, as far as I know, he describes a project that is the first of what we geodesists hope will become wide spread, of the U.S. Coast and Geodetic Survey's doing control work on a cooperative basis with a private organization under the provisions of the Act approved August 6, 1947.

That my paper presented at the Second Annual Texas Surveyors' Association Short Course was instrumental in arousing the interest of the Structural Engineer of the Dow Chemical Company is quite pleasing to me. If the other large land holders and sea concession owners will follow Dow's lead the struggle of the value of the "Precise Controlled Survey" will have been won.

1. Consulting Geodesist, San Antonio. Tex.

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